Appendix O

LNG Facility and Carrier Safety Record

LNG Land-Based Facility Safety Record

A review of available information is limited to land-based LNG facilities and indicates there have been only seven documented incidents with one or more (worker and/or public) fatalities associated directly with operations at land-based LNG facilities; (1) Skikda, Algeria, Jnauary 2004; (2) Bontang, Indonesia, (3) Maryland, United States, 1979; (4) Arzew, Algeria, 1977; (5) New York, United States, 1973; (6) Raunheim, Germany, 1966; and (7) Ohio, United States, 1944. Two of the seven incidents were related to construction or maintenance activities at the LNG facilities and not directly to LNG operations (CH-IV International 2006). These incidents include:

- **Skikda, Algeria, January 2004**. Available reports suggest that a gas cloud of unknown origin found a source of ignition in a boiler resulting in a large fire. Twenty-seven individuals were killed in the incident. The preliminary investigation suggests more liberal use of gas detection instruments in LNG facilities as a preventative measure, especially in the vicinity of air intake devices (CEC 2004; Kornfield et al. 2004).
- **Bontang, Indonesia, 1983**. An overpressure explosion occurred due to a valve being inappropriately in the closed position during facility maintenance. Three individuals were killed. Industry analysts have classified this as a maintenance accident since no LNG was present in the system (CH-IV International 2006). Current standards and practices for management of valves in relief systems should prevent recurrence of such an incident.
- **Maryland, U.S., 1979**. An explosion occurred in an electrical substation at a LNG receiving terminal. One individual was killed. No gas detection system was installed in the substation because natural gas was never expected to enter. As a result of the incident, design code changes were made and applied industry-wide (CH-IV International 2006).
- **Arzew, Algeria, 1977**. Due to the rupture of a cast aluminum valve, LNG was released from an inground storage tank. One worker was killed. Industry standard practice now is to use stainless steel for fabrication of large valves (CH-IV International 2006).
- **Staten Island, New York, U.S., 1973**. A LNG tank was out-of-service for repairs. Mylar and foam liner materials ignited, leading to temperature rise and pressure surge. The pressure surge caused a roof collapse, killing 37 workers who were inside the tank. The investigation classified this as a construction accident, not a LNG accident (CH-IV International 2006). Compliance with OSHA requirements for confined space entry and hot work should prevent recurrence of such an incident.
- **Raunheim, Germany, 1966.** Accidental venting occurred while LNG was being passed through a vaporizer that used a liquid level controller to operate below its maximum capacity of 4000 kg. The resulting vapor cloud drifted towards a control room resulting in fire and explosion, killing one. It was determined that the liquid level failed and as a result around 500 kg of LNG was vented out of the vaporizer (ÅF Industry AB and SSPA Sweden AB 2011).
- **Cleveland, Ohio, U.S., 1944.** A LNG storage tank built with low-nickel content steel failed shortly after being placed into service, resulting in a leak and subsequent fire that killed 128 people. The investigation concluded that, had the tank been built to code, the accident would not have occurred (CH-IV International 2006).

LNG Carrier Safety Record

Year	LNG Carrier	Incident
2012	*LNG Aries*	On June 20, 2012 off the coast of Oman, pirates attacked the Aries with rocket propelled grenades and small arms fire. The pirates moved to within 50 meters and fired shots, of which three rounds hit the tanker and damaged it. No one was injured during the attack and the LNGC evaded hijack. The LNGC was classified as safe and continued its scheduled voyage from Port Said to Suez.
2006	*Golar Freeze*	The LNGC moved away from its docking berth during unloading on March 14, 2006 in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed and transfer operations were shut down.
2004	*Tenaga Lima*	The *Tenaga Lima* grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 feet by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The ship was refloated, repaired and returned to service.
2002	*Norman Lady*	The USS Oklahoma City nuclear submarine struck the *Norman Lady* while rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG tanker, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull with minor leakage of seawater into the double bottom ballast tanks. No damage to the inner hull or the cargo system and tanks occurred.
2002	*Mostefa Ben Boulaid*	LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by a check valve leak, caused brittle fracturing of the steelwork. The ship's emergency shutdown system, water spray system and response of the crew resulted in a minimum of serious damage. Current ship design includes protective cryogenic metal protective plates under the transfer area, usually with a water flow, which protects the ship's deck. The ship was required to discharge its cargo, after which it proceeded to dock for repair.
2001	*Khannur*	A cargo tank overfilled into the ship's vapor handling system on September 10, 2001 during unloading at Everett, Massachusetts as a result of a malfunctioning valve. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After re inspection by the USCG, the *Khannur* was allowed to discharge its LNG cargo.
2001	*Methane Polar*	The ship collided with the bulk cargo ship Eastwind about 34 miles off the Algerian Coast. Although the *Methane Polar* sustained some damage, it remained in a stable condition and was later repaired. The Maritime and Port Authority stated that there were no reports of any cargo release or pollution from the collision.
1989	*Tellier*	The *Tellier* was blown from its docking berth at Skikda, Algeria in February 1989 during severe winds causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck causing fracture of some plating. As a result of this incident, LNG loading arms are now fitted with ship position monitoring devices, including transfer shutdown and emergency "dry break" couplings for disconnection of the loading arms.
1985	*Isabella*	LNG spilled onto its deck due to a cargo tank overflow in June 1985, causing severe cracking of the steelwork. The spill had been attributed to a cargo valve failure during discharging of cargo.
1980	*LNG Taurus*	The *LNG Taurus* grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The ship was refloated and the cargo unloaded.
1980	*LNG Libra*	The propeller shaft fractured while the ship was en route to Japan with a full cargo in October 1980. The ship was taken under tow, and the cargo was safely transferred to another LNG ship and delivered to its destination.

Year	LNG Carrier	Incident
1979	*El Paso Paul Kayser*	The ship grounded on a rock pinnacle in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG ship and delivered to its U.S. destination. The *El Paso Paul Kayser* proceeded to a shipyard under its own power with temporary repairs. LNG carriers are presently equipped with sophisticated navigation systems, including global positioning systems, which provides the ship's captain with the ship's exact position.
1979	*Pollenger*	A LNG spill onto the steel cover of cargo tank number one occurred while unloading at Everett, Massachusetts in April 1979. The spill caused cracking of the steel plate.